DEPARTMENT OF MATHEMATICS, OSMANIA UNIVERSITY

((w.e.f. the academic year 2018-19)

M. Sc. MATHEMATICS WITH COMPUTER SCIENCE

SEMESTER – III

Subject	Code	Paper	Hours/ Week	Theory	T*	Max. Marks	Credits
Core	MCS 301	**Elementary Number Theory**	6	5	1	100	5
Core	MCS 302	**Operating Systems**	4	4	-	100	4
Core	MCS303	**Programming in JAVA**	4	4	-	100	4
Elective	MCS 304(A)	**Operations Research**	6	5	1	100	5
	MCS 304(B)	**Mathematical Statistics**					
	MCS 304(C)	**Functional Analysis**					
Elective	MCS 305(A)	**Cloud Computing**	4	4	-	100	4
	MCS 305(B)	**Automata Theory**					
	MCS 305(C)	**Mobile Computing**					
Lab	MCS 302L	**Operating Systems Lab**	3	-	-	25	1
Lab	MCS 303L	**JAVA Lab**	3	-	-	25	1
		Seminar	2	2		25	1
			32				25

T* - Tutorial Class for Problem Solving Session.

SEMESTER – IV

Subject	Code	Paper	Hours/ Week	Theory	T*	Max. Marks	Credits
Core	MCS 401	**Integral Equations & Calculus of Variations**	6	5	1	100	5
Core	MCS 402	**Compiler Design**	4	4	-	100	4
Core	MCS 403	**Computer Networks**	4	4	-	100	4
Elective	MCS 404(A)	**Topology**	6	5	1	100	5
	MCS 404(B)	**Numerical Analysis**					
	MCS 404(C)	**Cryptography**					
Lab	MCS 402L	**Compiler Design Lab**	3	-	-	25	1
Lab	MCS 403L	**Computer Networks Lab**	3	-	-	25	1
Project		**Project**	6	-	-	100	4
		Seminar	2	2			1
			32				25

T* - Tutorial Class for Problem Solving Session.

DEPARTMENT OF MATHEMATICS
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M.Sc. Mathematics with Computer Science

MCS 301 **Semester III**

Paper-I: **Elementary Number Theory**

Unit I

The Fundamental Theorem of Arithmetic: Divisibility, GCD, Prime Numbers, Fundamental Theorem of Arithmetic, the series of reciprocal of the Primes, The Euclidean Algorithm.

Unit II

Arithmetic function and Dirichlet Multiplication, The functions $\phi(n), \mu(n)$ and a relation connecting them, Product formulae for $\phi(n)$, Dirichlet Product, Dirichlet inverse and Mobius inversion formula and Mangoldt function $\Lambda(n)$, Multiplication function and Dirichlet multiplication, Inverse of a completely multiplication function, Liouville's function $\lambda(n)$, the divisor function $\sigma_\alpha(n)$.

Unit III

Congruences, Properties of congruences, Residue classes and complete residue system, linear Congruences conversion, reduced residue system and Euler Fermat theorem, polynomial congruence modulo P, Lagrange's theorem, Application of Lagrange's theorem, Chinese remainder theorem and its application, polynomial congruences with prime power moduli.

Unit-IV

Quadratic residue and quadratic reciprocity law, Quadratic residues, Legendre's symbol and its properties, evaluation of $(-1/p)$ and $(2/p)$, Gauss Lemma, the quadratic reciprocity law and its applications.

Text Book:

Introduction to Analytic Number Theory by Tom M. Apostol. Chapters 1, 2, 5, 9. Spriger International, Student Edition.

References:

[1] Number Theory by Joseph H. Silverman.

[2] Theory of Numbers by K. Ramchandra.

[3] Elementary Number Theory by James K Strayer.

[4] Elementary Number Theory by James Tattusall.

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M.Sc. Mathematics with Computer Science

MCS 302 **Semester III**

Paper-II: **Operating Systems**

Unit I

Introduction: Computer-System Architecture, Operating-System Structure, Operating-System Operations, Process Management, Memory Management, Storage Management, Protection- Security, Kernel Data Structures, Computing Environments, Open-Source Operating Systems.

Operating-System Structures: Operating-System Services, User Interface for Operating-System, System Calls, Types of System Calls, Operating-System Design and Implementation, Operating-System Structure, Operating- System Debugging.

Process Management: Process Concept, Process Scheduling, Operations on Processes, Inter process Communication, Examples of IPC Systems, Communication in Client–Server Systems.

Threads: Overview, Multithreading Models, Threading Issues.

Process Synchronization: Concept, Critical-Section Problem, Peterson's Solution, Synchronization, Classic Problems of Synchronization, Semaphores, Monitors.

Unit II

CPU Scheduling: Concepts, Scheduling Criteria, Scheduling Algorithms, Thread Scheduling, Real-Time CPU Scheduling, Algorithm Evaluation.

Deadlocks: System Model, Deadlock Characterization, Methods for Handling Deadlocks, Deadlock Prevention, Deadlock Avoidance, Deadlock Detection, Recovery from Deadlock.

Unit III

Memory Management: Main Memory, Swapping, Contiguous Memory Allocation, Segmentation, Paging, Structure of the Page Table. Virtual Memory: Demand Paging, Page Replacement, Allocation of Frames, Thrashing, Memory-Mapped Files.

Unit-IV

Mass-Storage Structure: Overview, Disk Structure, Disk Scheduling, Disk Management, Swap-Space Management, RAID Structure, Stable-Storage Implementation.File Systems: File Concept, Access Methods, Directory and Disk Structure, File-System Mounting, Protection. File- System Structure and Implementation, Directory Implementation, Allocation Methods, Free-Space Management, Recovery, Network File System.

Protection and Security: Goals of Protection, Principles of Protection, Domain of Protection, Access Matrix, Access Control, Revocation of Access Rights.

Text Book:

AbrahamSilberschatz, Peter Baer Galvin, Greg Gagne, Operating System Concepts (9e)

References:

[1] Thomas W. Doeppner, Operating systems in depth.

[2] Andrew S. Tanenbaum, Modern Operating Systems.

[3] William Stallings, Operating Systems – Internals and Design Principles.

[4] Dhananjay M. Dhandhere, Operating Systems-A Concept Based Approach.

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M.Sc. Mathematics with Computer Science

MCS 303 **Semester III**

Paper-III: **Programming in JAVA**

Unit I

Review of Core Java: Class Object, Object Oriented Concepts with respect to Java, Interfaces, Packages and Exception Handling, Applets, Overview of Collection Framework (No question to be set from above topics).
AWT: Introduction, AWT Class Hierarchy, Creating Container, Adding Components, Layout, Using Panel, Text Field, Text Area, List, Checkbox, Check Box Group, Choice, Event Handling, Dialog Boxes, ScrollBar, Menu.
Swing: Containment Hierarchy, Adding Components, JTextField, JPasswordField, JTable, JComboBox, JProgressBar, JList, JTree, JColorChooser, Dialogs.
Remote Method Invocation (RMI): Introduction, Remote Method Invocation, Java RMI Interfaces and Classes, an Application, Compiling the Program, Generating Stub Classes, Running the Program, Callback with an Application.

Unit II

Servlet: Server-Side Java, Servlet Alternatives, Servlet Strengths, Servlet Architecture, Servlet Life Cycle, GenericServlet, HttpServlet, Servlet Example, Passing Parameters to Servlets, Retrieving Parameters, Cookies, Filters.
Java Server Pages (JSP): Introduction, JSP Engines, How JSP Works, JSP and Servlet, Anatomy of a JSP Page, JSP Syntax, JSP Components, Beans, Session Tracking, Users Passing Control and Data between Pages, Sharing Session and Application Data.

Unit III

Java Database Connectivity (JDBC): Introduction, JDBC Drivers, JDBC Architecture, JDBC Classes and Interfaces, Loading a Driver, Making a Connection, Execute SQL Statement, SQL Statements, Retrieving Result, Getting Database Information, Scrollable and Updatable Result set, Result Set Metadata.
Hibernate: Introduction, Writing POJO Class, Creating a Table, Writing a Hibernate Application, Compiling and Running Application, Book Application Using Annotation, Object Life Cycle, HQL, Using Native SQL Query, Named Queries, Generating DDL, Generator Class, Hibernate Tools.

Unit IV

Java Naming and Directory Interface (JNDI): Naming Concepts, Directory Concepts, Java Naming and Directory Interface, Specifying JNDI Properties, Name Servers, Naming Operations, Working with Directory.
Overview of J2EE, Introduction to JavaBeans, Advantages of JavaBeans, Properties of JavaBeans with examples, JavaBeans API, Enterprise JavaBeans (EJB), Applications using Session Beans and Entity Beans, Introduction to Struts Framework.
Java Server Faces (JSF): Introduction, Simple Application, Request Processing Life-Cycle, Tracing Phases, Managed Bean, Basic JSF Tags, Expression Language, Event Handling with Example, Page Navigation.

Text Book:

Uttam K. Roy, Advanced Java programming

References:

[1] Herbertt Schildt, Java Complete Reference.

[2] Cay S. Horstmans, Gray Coronell, Core Java Vol. II – Advanced Features.

[3] Sharanam Shah, Vaishali Shah, Java EE 7 for Beginners.

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M.Sc. Mathematics with Computer Science

MCS/M/AM 304(A) **Semester III**

Paper-IV: **Operations Research**

Unit I
Formulation of Linear Programming problems, Graphical solution of Linear Programming problem, General formulation of Linear Programming problems, Standard and Matrix forms of Linear Programming problems, Simplex Method, Two-phase method, Big-M method, Method to resolve degeneracy in Linear Programming problem, Alternative optimal solutions. Solution of simultaneous equations by simplex Method, Inverse of a Matrix by simplex Method, Concept of Duality in Linear Programming, Comparison of solutions of the Dual and its primal.

Unit II
Mathematical formulation of Assignment problem, Reduction theorem, Hungarian Assignment Method, Travelling salesman problem, Formulation of Travelling Salesman problem as an Assignment problem, Solution procedure.
Mathematical formulation of Transportation problem, Tabular representation, Methods to find initial basic feasible solution, North West corner rule, Lowest cost entry method, Vogel's approximation methods, Optimality test, Method of finding optimal solution, Degeneracy in transportation problem, Method to resolve degeneracy, Unbalanced transportation problem.

Unit III
Concept of Dynamic programming, Bellman's principle of optimality, characteristics of Dynamic programming problem, Backward and Forward recursive approach, Minimum path problem, Single Additive constraint and Multiplicatively separable return, Single Additive constraint and Additively separable return, Single Multiplicatively constraint and Additively separable return.

Unit-IV
Historical development of CPM/PERT Techniques - Basic steps - Network diagram representation - Rules for drawing networks - Forward pass and Backward pass computations - Determination of floats - Determination of critical path - Project evaluation and review techniques.

Text Books:

[1] S. D. Sharma, Operations Research.

[2] Kanti Swarup, P. K. Gupta and Manmohan, Operations Research.

[3] H. A. Taha, Operations Research – An Introduction.

[4] G.I. Gauss, Linear Programming.

DEPARTMENT OF MATHEMATICS
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M.Sc. Mathematics with Computer Science

MCS/M 304(B) **Semester III**

Paper-IV: **Mathematical Statistics**

Unit I

Probability: Sample space and events of an experiment, Properties of Probability experiments Equally likely outcomes, Conditional probability and independence, Bayes' Theorem.

Discrete Random Variables: Random variables, Expected value, Properties of expected values, variance of random variables, Properties of variances, Binomial random variables and its Expected value and variance, Hyper-geometric random variables, Poisson random variables.[ch 4, 5]

Unit II

Normal Random Variables: Continuous random variables, Normal random variables, Probabilities associated with a standard Normal random variable, Finding Normal probabilities. Problems on related.

Distributions of Sampling Statistics: Sample Mean, Central Limit Theorem, Distribution of the sample mean, Sample size needed, Sampling proportions from a finite population; Probabilities associated with sample proportions.

Estimation: Point estimator of a population mean, population proportion, Estimating a population variance,. (Ch. 6, 7, 8)

Unit III

Testing Statistical Hypotheses: Hypothesis tests and Significance levels, Tests concerning the mean of a Normal population: Case of known variance, One-sided tests; the t-test for the mean of a Normal population: Case of unknown variance, Hypothesis Tests Concerning Population Proportions. Two-Sided Tests of p.

Hypothesis Tests Concerning Two Populations: Testing equality of means of two Normal populations: Case of known and unknown variances and large Sample sizes, Testing equality of means: Small-sample tests when the unknown population variances are equal, Paired-sample t-test, Testing equality of population proportions. Problems on related. (Ch. 9, 10)

Unit-IV

Chi-Squared Goodness-of-Fit Tests: Chi-Squared Goodness-of-fit Tests, Testing for independence in Populations classified according to two characteristics, Testing for independence in contingency tables with fixed marginal totals.

Analysis of Variance: Introduction, One-factor and two factor Analysis of Variances, Parameter estimation, Degrees of freedom, Testing hypotheses. [ch11, 12]

Text Book:

Sheldon M. Ross (2010): Introductory Statistics, Academic Press, Elsevier, 3rd Edition. (chapters 4 to 12).

Reference:

Sheldon M. Ross (2010): Introduction to Probability Models, Academic Press, Elsevier, 10th Edition. (chapters 4 to 13).

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M.Sc. Mathematics with Computer Science

MCS 304(C) **Semester III**

Paper-IV: **Functional Analysis**

Unit I
Normed Spaces - Banach Spaces - Further properties of normed spaces - Finite dimensional normed spaces and sub spaces - compactness and finite dimension - linear operators - Bounded and continuous linear operators. [2.2, 2.3,2.4,2.5,2.6, 2.7].

Unit II
Linear Functionals - normed spaces of operators - Dual space - Inner product space - Hilbert Space - Further Properties of Inner product Spaces - Orthogonal complements and direct sums - Orthogonal sets and sequences. [2.8,2.10,3.1,3.2,3.3 and 3.4]

Unit III
Series related to Orthonormal Sequences and sets - Total Orthonormal sets and sequences - Representation of Functions on Hilbert spaces - Hilbert-Adjoint Operator - Self-Adjoint, unitary and normal operators. [3.5,3.6,3.8,3.9 and 3.10]

Unit-IV
Hahn-Banach Theorem - Hahn-Banach Theorem for Complex Vector Spaces and Normed Spaces - Adjoint Operator- Category Theorem - Uniform Boundedness Theorem - Open Mapping Theorem - Closed Linear Operators - Closed Graph Theorem. [4.2,4.3,4.5,4.7,4.12 and 4.13]

Text Book:

Introductory Functional Analysis with Applications by Erwin Kreyszig, John Wiley and sons, New York.

References:

[1] Functional Analysis by B.V. Limaye $2^n d$ Edition.

[2] Introduction to Topology and Modern Analysis by G.F.Sinmmons. Mc.Graw-Hill International Edition.

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M.Sc. Mathematics with Computer Science

MCS 305(A) **Semester III**

Paper-V: **Cloud Computing**

Unit I

Era of Cloud Computing (CC): introduction, cloud and other similar configurations, CC vs. peer-to-peer architecture, CC vs. client-server architecture, CC vs. GC, components of CC, impact of CC on businesses. Introduction Virtualization: Introduction, virtualization benefits, implementation levels of virtualization, virtualization at the OS level, virtualization structure, open source virtualization technology, Xen virtualization architecture, binary translation with full virtualization, para-virtualization with compiler support, virtualization of CPU, memory, I/O devices, hardware support for virtualization, virtualization in multicore processors. Cloud Computing Services: IaaS, PaaS, leveraging PaaS for productivity, guidelines for selecting a PaaS provider, concerns with PaaS, languages and PaaS, SaaS, DBaaS.Cloud Computing and Business Value: key drivers for CC, CC and outsourcing, types of scalability, use of load balancers to enhance scalability, variable operating costs using CC, time-to-market benefits of CC, distribution over the internet, levels of business values from CC. Cloud Types and Models: private cloud, public cloud, hybrid cloud.

Unit II

Adoption and Use of Cloud by Small and Medium Businesses: place of adoption, benefits, adoption phases, vendor roles and responsibilities, selection phases, provider liability, provider capabilities, success factors for CC Adoption process of public clouds by enterprises.Cloud migration techniques, Phases during the migration of an application to the cloud.IT Service Management for Cloud Computing: ITIL based service management, service strategy, service design, service transition, service operations, continual service improvement. SLA with Cloud Service Providers: concept, aspects and requirements of SLA, credit calculation, samples 1 and 3. Risks, Consequences, and Costs for Cloud Computing:introduction, risk assessment and management, risk of vendor lock-in, loss of control, not meeting regulatory compliances, resource scarcity, multitenant environment, failure, inadequate SLA, malware and internet attacks, management of cloud resources, network outages, in fracture, legal, licensing, TCO, cloud costs, cost allocations, chargeback models and methodology, billable items.

Unit III

REST-style Web Services: What is REST? HTTP methods, Java API for RESTful Web Services (JAX-RS), JAX-RS with Jersey, CRUD RESTful Web Service, SOAP and REST in Harmony, Interpretability between the Java Platform and WCF, WSIT, Web Services Security, Wire-Level Security, WS-Security.

Unit-IV

AAA Administration for Cloud: AAA model, single sign on for clouds, industry implementation for AAA, authentication management in the cloud, SAML, authentication for resource utilization. Security as a Service: benefits of security as a service, concerns with security as a service, security service providers, IdMaaS, attributes of IdMaaS providers.Cloud Certifications and Audits: certifications, cloud audit framework, cloud auditing requirements.Application Security in the Cloud: cloud application SDLC, cloud service reports by providers, application security in IaaS, PaaS and SaaS environments. Mobile Cloud Computing (MCC):architecture of MCC, benefits of MCC, MCC challenges.

Text Books:

[1] Rajkumar Buyya, Cloud Computing: Principles and Paradigms .

[2] Arshdeep Bahga, Vijay Madisetti, Cloud Computing – A Hands-On Approach.

[3] David E.Y. Sarna, Implementing and Developing Cloud Computing Applications.

[4] Kai Hwang, Distributed and Cloud Computing From Parallel Processing to Internet of Things.

DEPARTMENT OF MATHEMATICS
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M.Sc. Mathematics with Computer Science

MCS 305(B) **Semester III**

Paper-V: **Automata Theory**

Unit I

Fundamentals – alphabets, strings, languages, problems, graphs, trees, Finite State Systems, definitions, Finite Automaton model, acceptance of strings, and languages, Deterministic finite automaton and Nondeterministic finite automaton, transition diagrams, transition tables, proliferation trees and language recognizers, equivalence of DFA's and NFA's. Finite Automata with ϵ-moves, significance, acceptance of languages, ϵ-closure, Equivalence of NFA's with and without ϵ-moves, Minimization of finite automata, Two-way finite automata, Finite Automata with output– Moore and Melay machines..

Unit II

Regular Languages: regular sets, regular expressions, identity rules, constructing finite automata for a given regular expressions, conversion of finite automata to regular expressions. Pumping lemma of regular sets and its applications, closure properties of regular sets. Grammar Formalism: Regular grammars–right linear and left linear grammars, equivalence between regular linear grammar and finite automata, inter conversion, Context free grammar, derivation trees, sentential forms, right most and leftmost derivation of strings, ambiguity.

Unit III

Context Free Grammars: Simplification of Context Free Grammars, Chomsky normal form, Greiback normal form, Pumping lemma for context free languages and its applications, closure of properties of CFL (proofs omitted). Push Down Automata: PDA definition, model, acceptance of CFL, acceptance by final state and acceptance by empty state and its equivalence. Equivalence of PDA's and CFL's, inter-conversion. (Proofs not required).

Unit-IV

Membership Algorithm (CYK Algorithm) for Context Free Grammars. Turing Machine: TM definition, model, design of TM, computable functions, unrestricted grammars, recursively enumerable languages. Church's hypothesis, counter machine, types of Turing machines (proofs omitted). Linear bounded automata and Context sensitive language. Computability Theory: Chomsky hierarchy of languages, Introduction to DCFL, DPDA, LR(0) grammar, decidability and undecidable problems. Definitions of P and NP problems, NP complete and NP hard problems.

Text Book:

J. E. Hopcroft, J. D. Ullman, Introduction to Automata Theory, Languages, and Computation .

References:

[1] John C. Martin, Introduction to Languages and the Theory of Computation .

[2] Mishra, Chandrashekaran, Theory of Computer Science.

[3] Perter Linz, An Introduction to Formal Languages and Automata.

[4] ZviKohav, Niraj K Jha, Switching and Finite Automata Theory.

DEPARTMENT OF MATHEMATICS
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M.Sc. Mathematics with Computer Science

MCS 305(C) **Semester III**

Paper-V: **Mobile Computing**

Unit I
Introduction to Mobile Computing: applications, a simplified reference model,Wireless Transmission: frequencies of radio transmission, signals, antennas, signal propagation, multiplexing, modulation, spread spectrum, cellular system. Media Access Control: motivation for a specialized MAC, SDMA, FDMA, TDMA, CDMA, and Comparisons.

Unit II
GSM, DECT, Wireless LAN: Infrared vs. radio transmission, Infrastructure and ad-hoc networks, IEEE 802.11, HPERLAN, Bluetooth.

Unit III
Mobile Network Layer: mobile IP, dynamic host configuration protocol, ad-hoc networks.Mobile Transport Layer: Traditional TCP, classical TCP improvements, TCP over 2.5/3G wireless networks.

Unit-IV
File Systems,World Wide Web,Wireless Application Protocol (WAP) and WAP 2.0.

Text Book:

Jochen H. Schiller, Mobile Communications(2e)

Refernces:

[1] Raj Kamal, Mobile Computing.

[2] Asoke K. Talukder, Roopa R. Yavagal, Mobile Computing.

[3] Mazliza Othman,Principles of Mobile Computing and Communications.

[4] Prasant Kumar Pattnaik, Rajib Mall, Fundamentals of Mobile Computing.

[5] Ivan Stojmenovic,Handbook of Wireless Networks and Mobile Computing.

[6] David Taniar, Mobile Computing Concepts, Methodologies, Tools, and Applications.

DEPARTMENT OF MATHEMATICS
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M.Sc. Mathematics with Computer Science

MCS 302L **Semester III**

Operating System Lab

1. Write shell programs using 'case', 'then' and 'if' & 'else' statements.
2. Write shell programs using while, do-while and for loop statements.
3. Write a program to create a child process using fork(), exec() system calls and use other system calls.
4. Write a program to convert upper case to lower case letters of a given ASCII file.
5. Write a program to program to search the given pattern in a file.
6. Write a program to implementation of Signals in UNIX.
7. Write a program to simulate UNIX commands like ls, grep, cp.
8. Write a program to demonstrate FCFS and SJF process schedules on the given data.
9. Write a program to demonstrate CPU Priority and Round Robin Scheduling on the given burst time and arrival times.
10. Write a program to simulate Inter Process Communication using pipes.
11. Write a program to implementing Producer and Consumer problem using Semaphores.
12. Write a program tosimulate Bankers Algorithm for Dead Lock Avoidance
13. Write a program tosimulate Bankers Algorithm Dead Lock Prevention.
14. Write a program tosimulate Paging Techniques of memory management.
15. Write a program tosimulate FIFO, LRU, LFU Page replacement algorithms.
16. Write a program tosimulate Sequential, Indexed, and Linked file allocation strategies.

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MCS 303L **Semester III**

JAVA Lab

1. Create GUI to present a set of choices for a user to select stationary products and display the price of Product after selection from the list.
2. Create GUI to demonstrate typical Editable Table which describing Employee for a software company.
3. Create GUI to demonstrate swing components using student registration form.
4. Create a Remote Object for simple arithmetic operators. Use AWT/SWING to create user interface.
5. Write an RMI application using call back mechanism
6. Develop Servlet Question-Answer Application usingHttpServletRequest and HttpServletRequest interfaces.
7. Develop Servlet application to accept HTNO of a student from client and display the memorandum of marks from the server
8. JSP Programs
   (a) Create a JSP page that prints temperature conversion (from Celsius to Fahrenheit) chart
   (b) Create a JSP page to print current date and time
   (c) Create a JSP page to print number of times page is referred after the page is loaded.
9. Write a simple JSP application to demonstrate the use of implicit object (at least 5).
10. Develop a Hibernate application to Store Feedback of Website Visitors in MySQL Database.
11. Develop a JSP Application to accept Registration Details from the user and store database table.
12. Develop a JSP Application to Authenticate User Login as per the Registration Details.If Login Success then forward User to Index Page otherwise show Login failure Message.
13. Develop a web Application to add items in the inventory using JSF.
14. Write EJB applications using stateless session beans and state-full session beans.
15. Develop a Room Reservation System Application using Entity Beans.
16. Create Three-tire application using Servlets, JSP, EJB.

DEPARTMENT OF MATHEMATICS
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M.Sc. Mathematics with Computer Science

MCS/M/AM 401 **Semester IV**

Paper-I: **Integral Equations & Calculus of Variations**

Integral Equations:
Unit I
Volterra Integral Equations: Basic concepts - Relationship between Linear differential equations and Volterra Integral equations - Resolvent Kernel of Volterra Integral equation. Differentiation of some resolvent kernels - Solution of Integral equation by Resolvent Kernel - The method of successive approximations - Convolution type equations - Solution of Integro-differential equations with the aid of the Laplace Transformation – Volterra integral equation of the first kind - Euler integrals - Abel's problem - Abel's integral equation and its generalizations.

Unit II
Fredholm Integral Equations: Fredholm integral equations of the second kind – Fundamentals – The Method of Fredholm Determinants - Iterated Kernels constructing the Resolvent Kernel with the aid of Iterated Kernels - Integral equations with Degenerated Kernels. Hammerstein type equation - Characteristic numbers and Eigen functions and its properties.
Green's function: Construction of Green's function for ordinary differential equations - Special case of Green's function - Using Green's function in the solution of boundary value problem.

Calculus of Variations:
Unit III
The Method of Variations in Problems with fixed Boundaries: Definitions of Functionals – Variation and Its properties - Euler's' equation - Fundamental Lemma of Calculus of Variation-The problem of minimum surface of revolution - Minimum Energy Problem Brachistochrone Problem - Variational problems involving Several functions - Functional dependent on higher order derivatives - Euler Poisson equation.

Unit-IV
Functional dependent on the Functions of several independent variables: - Euler's equations in two dependent variables - Variational problems in parametric form - Application of Calculus of Variation - Hamilton's principle - Lagrange's Equation, Hamilton's equations.

Text Books:

[1] M. KRASNOV, A. KISELEV, G. MAKARENKO, Problems and Exercises in Integral Equations (1971).

[2] S. Swarup, Integral Equations, (2008).

[3] L.ELSGOLTS, Differential Equation and Calculus of Variations, MIR Publishers, MOSCOW.

DEPARTMENT OF MATHEMATICS
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M.Sc. Mathematics with Computer Science

MCS 402 **Semester IV**

Paper-II: **Compiler Design**

Unit I
Introduction: language processors, phases of a compiler, a model for a compiler front end, syntax-directed translation, parsing, a translator for simple expressions, Lexical Analysis: role of lexical analyzer, input buffering, specification of tokens, Lex lexical analyzer generator, data structures in compilation.Top-Down Parsing: Introduction, Context free grammars, writing a grammar, recursive-descent parsing, LL(1) grammars, predictive parsing, preprocessing steps required for predictive parsing.

Unit II
Bottom-Up Parsing:shift reduce parsing, SLR parsing, CLR parsing and LALR parsing, error recovery in parsing, handling ambiguous grammar, parser generator – YACC.Semantic Analysis: syntax-directed definitions, evaluation order for SDD's, application of SDT.

Unit III
Intermediate-Code Generation: syntax trees, three-address code, types and declarations, translation of expressions, type checking. Runtime Environment: storage organization, stack allocation of space, heap management, storage allocation for arrays, strings and records, introduction to garbage collection and trace based collection.

Unit-IV
Code Generation: issues in the design of code generator, target language, addresses in the target code, basic blocks and flow graphs, optimization of basic blocks, peephole optimization, register allocation and assignment. Code Optimization: principal sources of optimization, data flow analysis, constant propagation, partial redundancy elimination, loops in flow graphs.

Text Book:

A. V. Aho, Monica S. Lam, Ravi Sethi,J. D. Ullman, Compilers Principles, Techniques, & Tools, (2e)

References:

[1] Dick Grune, Henry E. Bal, Cariel T. H. Jacobs, Modern Compiler Design.

[2] Kenneth C. Louden, Compiler Construction Principles and Practice.

[3] Thomas w. Parsons, Introduction to Compiler Construction.

[4] Andrew N. Appel, Modern Compiler Implementation in C.

[5] John R. Levin, Tony Mason, Doug Brown, LEX & YACC

[6] Cooper, Linda, Engineering a Compiler.

DEPARTMENT OF MATHEMATICS
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M.Sc. Mathematics with Computer Science

MCS 403 **Semester IV**

Paper-III: **Computer Networks**

Unit I
Computer Networks Fundamentals: Overview, Network Hardware, Network Software, Reference models– OSI Model, TCP/IP Reference Model,Comparison of OSI and TCP/IP Reference Model, Example Networks, Network Standardization.
Physical Layer: Guided Transmission Media, Wireless Transmission, Multiplexing, Switching.
Data Link Layer:Design Issues, Error Detection and Correction, Data Link Layer Protocols, Sliding Window Protocol

Unit II
Multiple Access Sublayer: ALOHA, CSMA, Collision Free Protocols, Ethernet, Wireless LAN-802.11, Data Link Layer Switching–Repeaters, Hubs, Bridges, Switches, Routers, Gateways.
Network Layer: Design Issues, Routing Algorithms – Shortest path, Flooding, Distance Vector Routing, Link state Routing, Hierarchical, Broadcast Routing, Multi cast Routing; Congestion Control Algorithms.

Unit III
Internetworking: Tunneling, Internetwork Routing, Fragmentation, IPv4 Vs IPv6Protocol, IP Addresses, CIDR,Internet Control Protocols–IMCP, ARP, RARP, DHCP.
Transport Layer: Services provided to the upper layers,Transport Protocols, Overview of Congestion Control.

Unit-IV
The Internet Transport Protocols: Introduction to UDP&RPC, Real Time Transport Protocols, The Internet Transport Protocols–TCP, TCP Service Model, TCP protocol, TCP Segment Header, TCP Connection Establishment, TCP Connection Release, Modeling TCP Connection Management, TCP Sliding Window, TCPTime Management, TCP Congestion Control.
Application Layer: DNS, TELNET, E-Mail, FTP, HTTP, SSH, Overview of WWW.

Text Book:

AndrewS.Tanenbaum, David J Wetherall, Computer Networks(5e)

References:

[1] S S Shinde, Computer Network.

[2] William Stallings, Data and Computer Communications.

[3] Behrouz A. Forouzan,Data Communication and Networking.

[4] James F Kurose, Keith W Ross, Computer Networking – A Top-Down Approach.

[5] Behrouz A Forouzan, Firouz Mosharraf, Computer Networks A Top-Down Approach.

DEPARTMENT OF MATHEMATICS
OSMANIA UNIVERSITY

M.Sc. Mathematics with Computer Science

MCS/M 404(A) **Semester IV**

Paper-IV: **Cryptography**

Unit I
Simple substitution ciphers ; Divisibility and greatest common divisors Modular arithmetic ; Prime numbers, unique factorisation, and finite fields; Powers and primitive roots in finite fields; Cryptography before the computer age; Symmetric and asymmetric ciphers.

Unit II
The birth of public key cryptography,The discrete logarithm problem Diffie–Hellman key exchange,The El-Gamal public key cryptosystem, An overview of the theory of groups, How hard is the discrete logarithm problem?, A collision algorithm for the DLP.

Unit III
The Chinese remainder theorem, The Pohlig-Hellman algorithm, Rings, quotients, polynomials, and finite fields, Euler's formula and roots modulo pq, Primality testing.

Unit-IV
Pollard's $(p-1)$ factorisation algorithm, Factorisation via difference of squares, Smooth numbers and sieves, Elliptic curves, Elliptic curves over finite fields, The elliptic curve discrete logarithm problem, Elliptic curve cryptography.

Text Book:

Mathematical Cryptography by Jeffrey Hoffstein, Jill Pipher, Joseph H. Silverman.

References:

[1] Everyday Cryptography: Fundamental Principles and Applications by Keith Martin.

[2] Cryptography: An Introduction by N. P. Smart.

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MCS 404(B) **Semester IV**

Paper-IV: **Numerical Analysis**

Unit I

Transcendental and Polynomial equations: Introduction, Bisection method, Iteration methods based on first degree equation; Secant method, Regulafalsi method, Newton-Raphson method, Iteration method based on second degree equation; Mullers method, Chebyshev method, Multipoint iterative method, Rate of convergence of secant method, Newton Raphson method,(Algorithms of above methods).

Unit II

System of linear algebraic equation: Direct methods, Triangularization method, Cholesky method, Partition method, Iteration method: Jacobi Iteration method Gauss Seidel Iterative method, SOR method.

Unit III

Interpolation and Approximation: Introduction,Lagrange and Newton's divided difference interpolation, Finite difference operators, Hermite interpolation, piecewise and Spline Interpolation, least square approximation. (Algorithms on Lagrange and Newton divided difference Interpolation).

Unit-IV

Numerical Integration: methods based on Interpolation, Newton's cotes methods, methods based on Undetermined coefficients, Guass legendre Integration method, Numerical methods ODE: Single step methods: Eulers method, Taylor series method, Runge-Kutte second and forth order methods, Multistep methods: Adam Bash forth method, Adam Moulton methods, Milne-Simpson method predictor and corrector methods. (Algorithms on Trapezoidal, Simpson, Eulers&Rungge-Kutte methods only).

Text Books:

[1] Numerical Methods for Scientific and Engineering computation by M.K. Jain, S.R.K. Iyengar, R.K. Jain, New Age Int. Ltd., New Delhi.

[2] Computer Oriented Numerical Methods by V. Rajaraman.

Reference:

Introduction to Numerical Analysis, by S.S. SastryPrentice Hall Flied.

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M.Sc. Mathematics with Computer Science

MCS 404(C) **Semester IV**

Paper-IV: **Topology**

Unit I
Topological Spaces: The Definition and examples-Elementary concepts-Open bases and open subbases-Weak topologies.

Unit II
Compactness: Compact spaces- Products of spaces-Tychonoff's theorem and locally compact spaces-Compactness for metric spaces-Ascoli's theorem.

Unit III
Separation: T_1-spaces and Hausdorff spaces-Completely regular spaces and normal spaces-Urysohn's lemma and the Tietze extension theorem-The Urysohn imbedding theorem.

Unit-IV
Connectedness: Connected spaces-The components of a spaces-Totally disconnected spaces-Locally connected spaces.

Text Book:

Introduction to Topology and Modern Analysis (Ch 3,4,5,6) By G.F. Simmons, TATA McGraw-Hill Publishing Company Ltd.

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M.Sc. Mathematics with Computer Science

MCS 402L **Semester IV**

Compiler Design Lab

1. Write a program to design token separator for the given expression.
2. Write a program to implement a symbol table.
3. Write a program to develop a lexical analyzer to recognize a few patterns.
4. Write a program to develop a lexical analyzer using Lex tool.
5. Write a program to recognize a valid arithmetic expression using YACC.
6. Write a program to recognize a valid variable name using YACC.
7. Write a program to implement calculator using Lex and YACC.
8. Write a program for implementing type checking for given expression.
9. Write a program to convert the BNF rules into YACC.
10. Write a program to implement data flow and control flow analysis.
11. Write a program to implement stack storage allocation strategies.
12. Write a program to implement heap storage allocation strategies.
13. Write a program to construct a directed acyclic graph (DAG).
14. Write a program to implement the back end of the compiler.
15. Write a program to implement simple code optimization technique.
16. Write a program to implement simple code optimization technique using do-while.

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M.Sc. Mathematics with Computer Science

MCS 403L **Semester IV**

Computer Networks Lab

1. Program to identify the category of the IP address for the given IP address
2. Program to implement sliding window protocol
3. Program for Socket pair system call usage in IPC
4. Program for Socket options using signals
5. Program to implement Echo concurrent Stream Server
6. Program to implement Echo concurrent stream client
7. Program to implement Listener and Talker
8. Program to implement TCP time service
9. Program to implement UDP time service
10. Program to implement Ping service
11. Program to implement Route tracing program
12. Program to implement File Transfer Protocol
13. Program to implement any Shortest path routing Algorithm
14. Program to implement Distance Vector Routing Implementation
15. Program to implement ICMP Error Message simulations
16. Program to implement Reverse Address Resolution Protocol